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Farm Fishponds

Verne E. Davison
Soil Conservation Service

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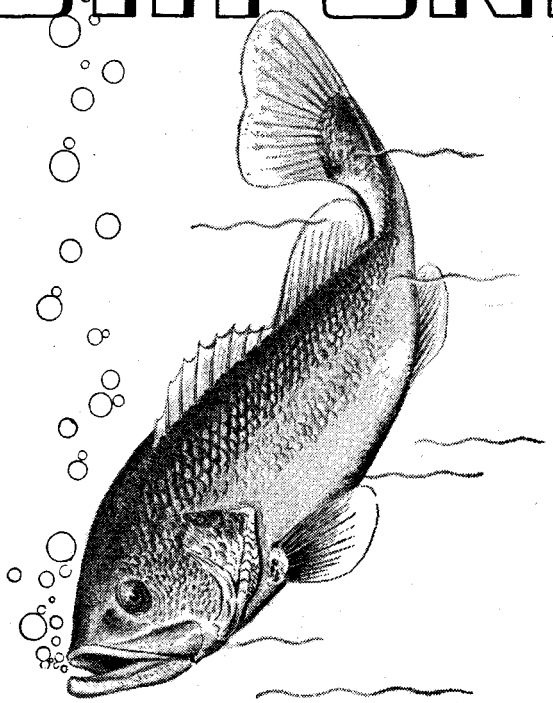

for FOOD AND GOOD LAND USE

Farmers' Bulletin 1983
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AN important part of soil and moisture conservation is making the best use of every acre on the farm. Where a suitable site for a farm pond exists, no better use can be made of such land than to develop it for the production of fish for the farm family. The recreation the pond affords adds much to the pleasure of rural life.

Thousands of farms have good pond sites. Properly developed and managed ponds may provide both food and pleasure to more than a million farm people.

This bulletin tells how to have good ponds. It explains how to manage such ponds to assure rapid production of an ample supply of fish. It points out the importance of selecting suitable sites, building good dams and spillways, and protecting ponds from flood and erosion. It tells how to stock the pond with fish. These things insure a lasting pond that may be fished many times a year.

This bulletin supersedes Farmers' Bulletin No. 1938, Fish for Food from Farm Ponds.

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FARM FISHPONDS FOR FOOD AND GOOD LAND USE

By VERNE E. DAVISON, *Senior Biologist, Biology Division, Soil Conservation Service*[1]

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INTRODUCTION

Many farms have good sites for ponds. If ponds are built right, their waters can be managed for fish. A fishpond makes better living on the farm. A single acre of water can be made to yield 150 to 450 pounds of pan-size fish each year. To produce them will cost only a few cents a pound. Once you have built your dam, you cannot grow field crops or livestock for food any cheaper.

Fresh fish in farm diets aid the proper development of growing children. Such foods contribute to the strength and soundness of the Nation's rural youth. They also improve the health of adults and keep them fit for work. The average person in the United States eats 163 pounds of meats, including red meats, fish, and fowl. An acre of fertilized pond (see p. 7) will produce far more meat than the average person needs. Fish, of course, should not replace all other meats. It can be used to add pleasant variety and essential food elements to the diet. Fish is a good source of proteins and fats and is high in phosphorus.

Under the stress of long hours and hard work, families on the land need recreation. The recreation afforded by a good fishpond is hard to surpass (fig. 1).

[1] For their many valuable suggestions and for their review of the manuscript, the author is indebted to the Regional Biologists of the Soil Conservation Service—Frank C. Edminster of Region 1, Wallace L. Anderson of Region 3, Philip F. Allan of Region 4, Marvin S. McMurtrey of Region 5, Adrey E. Borell of Region 6, and Richard M. Bond of Region 7. The author is further indebted to Edward H. Graham, Chief of the Biology Division, Soil Conservation Service, Lawrence V. Compton, Assistant Chief of the Biology Division, and Paul M. Scheffer, formerly of the Biology Division, for their assistance in the revision of this bulletin.

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FIGURE 1.—Fishing in their own pond gives a measure of satisfaction to the farm family.

MANAGEMENT OF FISHPONDS

Any pond will support some fish. With proper care it will produce more. A pond must be deep enough. It must contain the right kinds of fish. It should be free of pond weeds. The watershed should be protected by carrying out soil conservation measures.

If we are going to grow fish, we want to produce and harvest a lot of them in usable sizes. There are many ways to mismanage ponds for fish. They result in disappointment—poor fishing. It is easy to start a pond right, but it is hard to correct the mistakes of a pond started wrong. The things you must do to have a good pond are in direct conflict with some former theories. Many mistakes can be avoided by following the recommendations in this bulletin. You cannot afford to try experiments on your pond if you want good fishing.

We must think of pounds as well as numbers of fish. Your pond can feed just so many pounds of fish per acre of water. The total weight of fish is governed by the fertility of the pond water. In natural ponds an acre of water may support as little as 20 and seldom more than 200 pounds of fish. By putting ordinary commercial fertilizer into these same ponds they can be made to support 400 to 600 pounds of fish. We must stock, fertilize, and fish our ponds with *the pounds of fish per surface acre as our guide.*

The section on How to Stock a Pond with Fish tells you what numbers and kinds of fish to place in a pond. It also explains how bass can keep the numbers of fish in correct relation to the food supply.

Once started correctly, the fish will manage themselves, if you maintain good fertility and control the pond weeds. You can learn how and when to fertilize from the section on Fertilizing. An acre of water may require up to 1,500 pounds of fertilizer every year, usually 800 to 1,200 pounds.

Fertilizer also controls certain kinds of water weeds, strange as that may seem. The section on Weed Control explains this problem and its solutions.

Fishing is the thing you are trying to produce and, of course, you don't want to overdo it. Happily, you can't overfish a good pond! The section on Fishing goes into detail on this enjoyable part of pond management. The section on Draining the Pond is for those who may have trouble, and for those few who may want to harvest all their fish at one time.

You can have a pond which is very easy to manage, or you can have one that cannot be managed well with any amount of effort. The difference is usually made when you select the site and build the pond. Thousands of farms have at least one good site, but many others have no suitable place for a pond. Even the good sites can be made better if you know how. The sections on How to Build a Good Pond and Choosing a Location are therefore very important.

You must consider the influence of soil and water conservation on your pond. The section on Protecting the Pond from Erosion points out the things that insure a lasting pond.

We cannot overlook any of these things that are parts of pond management. If we do, we may have a lot of "old ponds" that are unproductive and need correction. The last section on Old Ponds tell how to overcome the difficulties encountered when we rework an unsatisfactory job.

A good farm pond may have several uses. Irrigation, stock watering, and swimming are among its uses. Growing fish is an important one. No recommendation in this bulletin is harmful to livestock, swimming, or irrigation.

LAWS

Before you build your farm pond, stock it with fish, or harvest the fish in it, you should learn the State laws that govern these operations. Not all States have such laws, but some do.

Some States have laws that regulate:

The size and design of dam and spillway.
The draining of ponds.
The kinds of fish that may be stocked.
The time of year that fishing may be done.
The sale of fish and fishing privileges.
The use of seines and fish poison.

Find out what your State laws are before you start your pond.

HOW TO STOCK A POND WITH FISH

To avoid too many undersize fish, you must stock the pond with the right kinds of fish and start them off in proper numbers. Most ponds contain too many fish. The fish are therefore small and few are of usable size. Fish grow rapidly when they get enough food. Yet, you must remember, the supply of fish food is limited in every pond. When fish are too plentiful, they get enough food to remain alive but not enough to grow. That is why the number of fish must be limited if good fishing is to result.

Fish grow to pan size in a single year in ponds that are properly stocked. A pond should therefore provide good fishing within a year. With proper care it should continue to do so year after year. Bluegills and large-mouth bass are best for most farm ponds. This combination is the simplest to manage and will yield the most pounds of usable fish. The large-mouth bass will keep the little fish under control. To breed successfully, large-mouth bass require a water temperature of about 70° F., at least for a few weeks each year. If you don't have temperature records, watch the children. A pond that youngsters swim in regularly is usually warm enough for bass.

Some pond owners want catfish, crappie, or other kinds of fish. Experience shows that these species with either bluegills or bass seldom improve the fishing. They usually cause trouble. Furthermore, a pond that contains only one kind of fish will usually *not* provide successful fishing.

Crappie, which are also known as white perch, are not suitable for small ponds. Unless your pond is larger than 5 acres and has considerable deep water you will be disappointed with crappie.

Catfish have not been successfully managed in the kind of ponds recommended here. Bass eat too many of the little catfish in weedless ponds. Without bass they become too abundant. So they are not dependable.

Bass feed largely on little fish, including their own young. Thus they prevent overpopulation in the pond. This principle applies to every fishpond regardless of its size. Bass do not grow satisfactorily unless they have small fish such as bluegill to feed upon.

If too many fish are stocked, there will not be enough food for each to reach pan size (fig. 2). With plenty of food, a bluegill will grow to 4 or 5 ounces in 1 year. Bass will grow to about 1 pound in the same time. The correct rate of stocking a fertilized pond is: 100 bass fingerlings and between 1,000 and 1,500 bluegill fingerlings per surface acre of water. Fish stocked at this rate will become pan size before their total weight reaches 400 to 600 pounds—the carrying capacity of a well-fertilized pond. This stocking rate is too great if you fail to fertilize the pond properly.

It is difficult to estimate the stocking rates for unfertilized ponds, unless you know how many pounds of fish your waters will support. A rate of 400 bluegills and 30 or 50 bass per acre is about right for a pond with food enough for 150 pounds of fish. If your pond will support more or fewer pounds, the numbers should be changed accordingly.

An understocking of bass will result in poor fishing. A few bass cannot prevent an overpopulation of bluegills during the summer spawning season. When bass are too few, the early-hatched bluegills grow rapidly until they reach the pond's capacity. Then they stop growing. These half-grown bluegills may be large enough to lay eggs. Yet they are not big enough for the frying pan. They are, however, too large for the bass to eat. Under these conditions neither bass nor fishermen reduce the bluegills to a reasonable number. Although the bass lay plenty of eggs, they raise no young because the hundreds of half-starved bluegills eat the eggs out of the spawning beds. Consequently, fishing is poor because the few bass have more than they need to eat, and the bluegills are too small for the table.

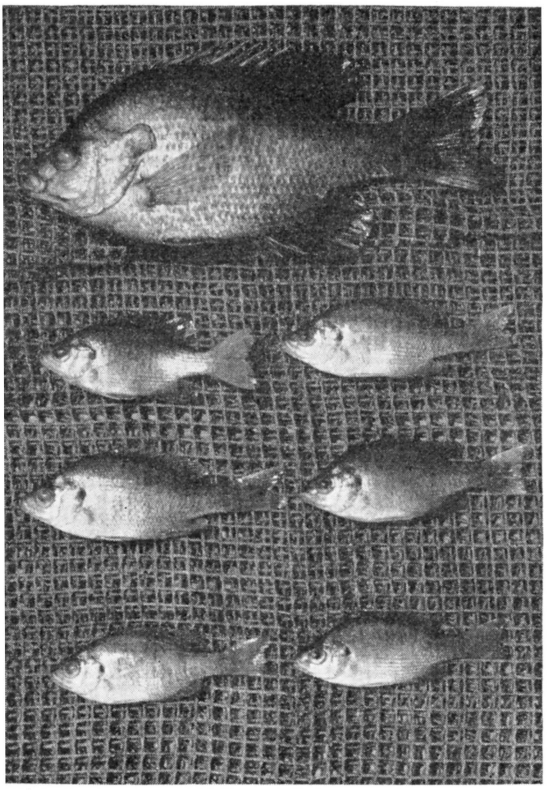

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FIGURE 2.—The large bluegill is from a correctly stocked pond where it obtained sufficient food to reach pan size within a year. The small ones failed to grow because they were in a pond where there were too many fish for the amount of food available.

A partial stocking with bluegills is also a mistake. A few adults placed in the pond before the bass are added will immediately overstock it. A single pair will raise 10 to 20 thousand fingerlings. No pond can have enough food to grow such large numbers to pan size. Remember that no more than 1,500 bluegills can reach usable size in a 1-acre pond—even when fertilized heavily.

You must be sure there are no wild fish in your pond before stocking. Wild fish such as perch, sunfish, suckers, catfish, and carp are in most streams, spring heads, and old ponds. Even though they are no larger than minnows, they are old enough to reproduce. These little fish begin to grow as soon as you raise the water in the pond or fertilize it. They will be large enough to spawn in only 6 or 8 weeks. Just a few of these wild fish will overstock the pond before the hatchery fish are

delivered. This overstocking can be avoided by the use of derris powder (containing rotenone) to kill every fish in the pond. Rotenone should be used if possible while there is only a small amount of water in the pond. If there is an old pond on the watershed above the new pond the wild fish should be removed from it, too. Otherwise, fish will wash from the upper pond into the new one and the stocking will not be right.

A stocking of fish for a new pond may be obtained from the United States Fish and Wildlife Service or the State fish and game departments. In some States pond fish must be purchased from private hatcheries. They are usually very inexpensive. Farmers who cooperate with soil conservation districts may obtain fish for their ponds through their local district organization. Applications for fish should give the exact size of the pond, figured to the nearest tenth of an acre. You should state whether or not the pond will be fertilized. The kind of fish already in the pond must be determined to know what, if any, fish you need, and what fish you should get rid of.

Bass and bluegills may be stocked at the same time or bluegills may be stocked ahead of bass. You will want the bluegills as early as possible. They grow fast during the few weeks before cold weather, thus reaching a large size before they spawn the following summer. They will usually spawn from June through October.

If bass of fingerling size are not available in the fall, small fingerlings 3 to 6 weeks old must be added the next spring. This delayed stocking of bass is satisfactory, but you should not remove any bass until they have hatched a crop of young in the pond—a year later. The stocking of bass should never be delayed beyond the May or June following the stocking of bluegills. These bass are needed to eat the thousands of little bluegills that will begin to hatch in early summer.

Ponds never need restocking unless something unusual has happened to the fish. You can tell whether the fish in your own pond are doing well by passing a minnow seine through the shallow water. If the balance between the bass and bluegills is correct, you should be able to catch a few 1- to 3-inch bass by seining at the pond edge during May, June, or July. These fingerlings are the current spring hatch. They will replace any large ones caught thereafter. Finding them present proves that the bluegills were not numerous enough to be starved into eating all the bass eggs. It also assures you of a continuing correct ratio in poundage between bass and bluegills.

As long as the food supply is adequate, the seine, used in any month when bluegills normally hatch, will also reveal many little bluegills. Failure to find fingerling bass or bluegills during these months is a certain indicator that something is wrong.

Among the things that may be wrong are:

Too many weeds; bass cannot control the little fish where weeds give too much protection. The weeds should be removed.

Lack of fertility; you may need to fertilize the pond again.

Too much floodwater; it washes out fish and replaces fertilized water with less fertile runoff.

Not enough bass; occasionally you lose some of the little bass the first year after stocking—with results the same as if you understocked. You should stock again with the number originally required.

FERTILIZING

Fertilizer placed in a pond accomplishes *three things:* First, *it greatly increases the food for fish;* second, *it controls submerged pond weeds;* and third, *it makes fishing more successful.* For these reasons you should fertilize your farm pond. A pond that is always muddy or one that becomes muddy with every rain cannot be fertilized successfully.

Microscopic plants called algae grow in all pond waters. There are many kinds but most of them are too small to be seen without a microscope. These extremely small plants provide food for insects and water animals that are in turn eaten by fish. Microscopic algae are the basic food supply for fish. It is the pasturage, so to speak, which grows insects in water. It takes considerable food to grow a pound of fish—just as it does to grow beef or pork.

Bluegills, more than bass, feed upon the aquatic insects that live within the pond. Those insects that fall into the water or are caught while flying close to the surface are less important. Contrary to common belief, pond fishes do not depend on water weeds for food. Neither do the insects.

Microscopic plants multiply to huge numbers when sufficient nitrogen, phosphorus, potash, and other essential materials are present in the pond water. Most ponds need more of these elements. Commercial fertilizer provides them and builds up the food supply so that each acre of a pond will support from 400 to 600 pounds of fish. Well-fertilized waters contain algae in such tremendous numbers as to cloud the water with a green or brown color. The density of this color will be your guide to fertilization.

The amount of nitrogen, phosphorus, and potash contained in a fertilizer is stated in percent. A fertilizer that contains 3 percent of nitrogen, 8 percent phosphorus, and 5 percent potash is called a 3–8–5 fertilizer. Various mixtures of fertilizers are locally available. Whether your common fertilizer is 6–8–4, 4–8–4, 5–10–5, or something else, you can use it.

An 8–8–4 fertilizer adds the proper amounts of these elements to the water. By adding sodium nitrate or ammonium sulphate, most common fertilizers can be made the equivalent of 8–8–4. As examples:

To 100 pounds 4–8–4 mixture add 20 pounds sodium nitrate or ammonium sulfate.
To 100 pounds 6–8–4 mixture add 10 pounds sodium nitrate or ammonium sulfate.
To 100 pounds 3–8–5 mixture add 25 pounds sodium nitrate or ammonium sulfate.
To 50 pounds 8–16–8 mixture add 20 pounds sodium nitrate or ammonium sulfate.

For each application of fertilizer, use about 100 pounds of 8–8–4, or its equivalent, per surface acre of water. It won't hurt to put twice that amount, or more, if you prefer. Most ponds will require from 800 to 1,200 pounds of fertilizer for each acre every year. A pond with considerable water running through it will need the heavier applications. You will not get good results if you use insufficient amounts of fertilizer.

There are ponds which seldom need fertilizer. Sometimes these are

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already fertilized by runoff water from the manure in cow lots. If a fresh application of fertilizer washes into the pond from surrounding land, the fertility of the water will be high by accident. The color test should tell you when to fertilize.

You begin to fertilize a new pond well before the fish are delivered. This keeps submerged weeds from starting and grows a full supply of insects for the new fish. Fertilizer should be applied weekly until the water becomes so clouded with algae you cannot see the bottom or a bright object 12 inches under the surface. Measure it; you don't have to guess. Most ponds require 3 to 6 weekly applications to raise the fertility level to meet this color test. They then need fertilizer again only when the water begins to clear a little. Time intervals need not be regular—can hardly be if you follow the color as a guide.

Applications need not be made during the winter. Fertilization during the cold winter months yields only minimum returns. The exception is: If you have an old pond where weeds are already present, you will find winter fertilization necessary to control the weeds. (See the following section on Weed Control.)

You can apply fertilizer to a small pond by walking around the edge and broadcasting the material toward the center by hand. Or you may apply it from a boat by pouring the fertilizer over the end of the boat in all waters between 1 and 5 feet deep (fig. 3). Of course, large ponds must be fertilized by boat. The fertilizer should be well distributed

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FIGURE 3.—Fertilizer is easily distributed in a pond by pouring it over the end of a boat.

through the areas of water less than 5 feet deep. Wave action will assure even distribution over the pond.

Organic fertilizers, such as cottonseed meal, hay, and manure, vary greatly in fertilizer value so it is difficult to make definite recommendations for their use. The yield of fish per ton of organic fertilizers is low, making them less economical than commercial fertilizers. Organic materials tend also to produce undesirable pond scum.

WEED CONTROL

Waterweeds of every kind are undesirable in fishponds. They interfere with fishing and are entirely unnecessary as food or cover for fish. They foster the breeding of mosquitoes, and they hide too many little bluegills from the bass. Pond weeds often give fish a strong "fishy" flavor. In a fishpond all leafy water plants are waterweeds. They use the fertility of a pond without increasing food for fish. They should be kept out of the pond.

Seventy-five or eighty percent of the pounds of fish in your pond should be fish large enough to use. In weedy ponds most of the weight is in thousands of small fish; bass are unable to catch enough of them in the weeds.

Waterweeds fall into four classes for purposes of control:

1. Weeds with leaves beneath the surface of the water can be shaded out by fertilization. The vast increase of algae in fertilized ponds clouds the water and shuts out the sunlight. This keeps submerged weeds from growing. Where weeds of this type are already established, fertilizer must be broadcast evenly over the weed beds beginning in January. This treatment brings on a heavy growth of pond scum (filamentous algae). The scum smothers and kills the weeds with a blanket of shade. Of course winter fertilization cannot be done where the pond is covered with ice.

2. Shallow-water plants such as cattails, parrotfeather, and marsh grasses must be controlled by hand. Fertilizer cannot stop them from growing because their leaves extend out of the water to reach sunlight. Weeds of this type appear first at the edge of a pond and grow abundantly in shallow water. For this reason a pond should be deepened at the edges as explained on page 22. Shallow-water plants can be kept out only by removal of the plants at frequent intervals. This is not difficult if you will pull individual plants before they produce seed or spread by root growth into colonies. You can use an ordinary shovel for this purpose, but pulling by hand is also easy. When left all summer, shallow-water plants become heavily rooted and more difficult to eradicate.

3. Pond lilies, lotus, and similar plants have heavy roots in the soil and broad leaves that float on the pond surface. They can be kept out of a new pond by pulling when they first appear (as in the case of shallow-water plants). If these waterweeds are already in a pond they may be destroyed by repeatedly cutting off the leaves. This exhausts and starves the big roots which need food manufactured by the leaves. The leaves should be cut slightly below the surface of the water. Five or six cuttings will be required the first summer and perhaps a few

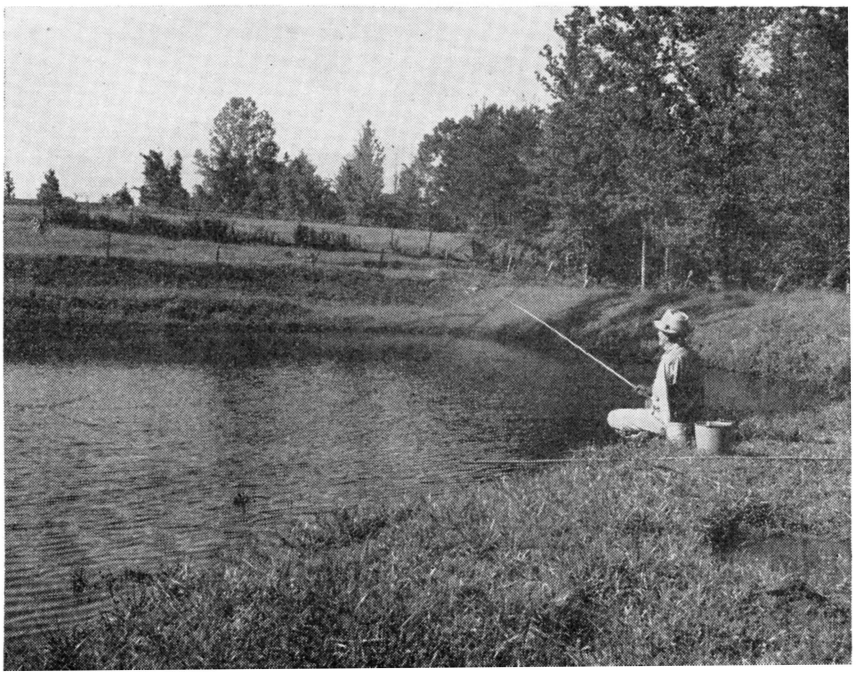

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FIGURE 4.—A cleared strip around the pond improves fishing, reduces the breeding places of mosquitoes, and keeps the pond free of undesirable debris.

additional cuttings early the second year before the plant food in the roots is exhausted. New plants from seeds may appear in shallow water or where fertilization is insufficient to shade them out. These new plants are easily pulled.

Weeds and brush on the banks of the pond should also be controlled. Fishing will be easier. Snakes won't be attracted and the pond will be easier to maintain. A strip at least 15-feet wide should be cleared next to the water's edge. Double this width is better. It should be grazed or mowed to maintain a low grasslike cover (fig. 4).

4. Pond scum (*filamentous algae*) grows on all decaying organic matter in ponds. It grows heavier in well-fertilized ponds—as long as weeds, grass, leaves, and woody stems are present. Avoid it by keeping such materials out of the pond. It is, you remember, the same plant we stimulate by winter fertilization to kill out submerged weeds in old ponds.

Whether or not livestock should be fenced away from a pond is a question that local conditions alone can answer. Stock will control weeds and grass along the water's edge, thus saving hand work. On the other hand, better sanitation and less muddying of the water is assured by fencing. In dry areas of the Western States, cattle concentrate about ponds, removing all grass and other vegetation. They often seriously damage the dam. If livestock muddy the pond much

by wading, you will have to fence them out in order to fertilize it successfully.

FISHING

In the second year after it is stocked and fertilized, your pond will contain its limit of fish—measured by weight. No more pounds of fish will be produced unless you remove some fish. As fish are taken out, enough food is released to grow an equal number of pounds. Thus the remaining fish will gain 10 pounds if 10 pounds are caught out, or 100 pounds if 100 pounds are removed. The rate of growth is therefore slow when little fishing is done. It reaches its most rapid rate when heavy fishing is practiced.

After a well-fertilized pond has become established, about 80 percent of the total weight of fish will be of usable size. In any 12-month period about 50 percent of the usable fish can be caught by hook-and-line fishing. This is true only if both bass and bluegills are caught. About one-third of the weight will be bass—a possible catch of 50 to 100 pounds per acre, including all sizes from one-half pound to the "big one." The other two-thirds will be bluegills—a catch per acre of 100 to 200 pounds, including all sizes large enough to eat. The total yield of bass and bluegills can be above 200 pounds per acre every year.

Fishing a newly stocked pond should begin with each species of fish as soon as it has reproduced. When young fish are present, the next year's crop is assured. The old fish can then be taken as fast as you can catch them. You can know when each species has spawned by using a minnow seine as discussed on page 6.

If you want to catch a good yield of pond fish with a reasonable amount of effort and success, you must take advantage of every favorable means of fishing. Bass bite best in the springtime when their food supply is lowest. They are taken on minnows, flies, plugs, and other artificial lures. A closed season at spawning time is entirely unnecessary after the bass have spawned once. There is no danger of hurting the breeding stock by hook-and-line fishing. If you catch a fish large enough to eat, its removal and use is good sense at any time of the year.

You can catch bluegills easiest from the spawning beds, using worms, crickets, grasshoppers, or similar baits. The larger adults gather on and around the beds and a string of fish can usually be taken in a short time. Again, there is no danger of taking enough to interfere with reproduction. To take the most bluegills you should fish for them on the pond bottom since most of their foods are eaten there. Small fish hooks are necessary as their mouths are too small for large hooks. One of the most exciting ways of catching bluegills is with small artificial trout flies played upon the surface, particularly late in the evening.

Alternating periods of good and poor fishing are to be expected in all ponds that are adequately fished. When a number of fish are removed, their food is left for those that remain. Since the food for the remaining fish is increased, they bite less readily. During this short period of poorer fishing, the fish grow rapidly. As the total

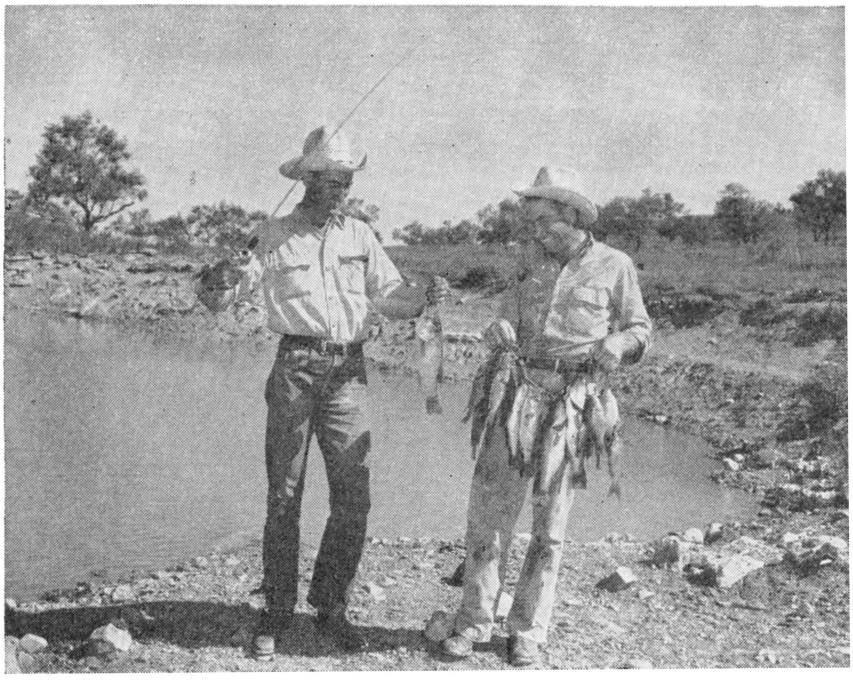

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FIGURE 5.—Fishing is good when you can catch a mess of pan-size fish with a reasonable amount of time and effort.

weight which the pond can support is approached, they bite more and more readily, and fishing once again becomes "good."

Failure to use the harvestable crop of fish is wasteful of fish and fertilizer. The most successful producer of pond fish is the owner who catches the most pounds per acre. Fishing is good only when you can catch a mess of pan-size fish with a reasonable amount of time and effort (fig. 5). A pond has only a few fish of "record-breaking size." There is little point in trying to produce very large ones. Nevertheless those that "get by" longest will become large if fish of all sizes are removed whenever they get on the hook. *A good pond will stand fishing just as often as the fish will bite.*

DRAINING THE POND

The quickest and surest cure for a mistake in stocking is to drain the pond and restock it correctly. Although you may not expect anything to upset the balance in a pond, this may occur. Fish have been known to die from unexplained causes and undesirable fish may gain entrance to the pond. Most of its faults can be corrected easily if you will provide the pond with a drain when the dam is built.

You may wish to harvest all of the fish at one time. In case you do, the best means of obtaining all the pan-size fish is by draining the pond. Fertilized waters will support a crop of something like 300 to 450 pounds of usable fish per acre. Yet only about one-half of

that weight can be caught in a whole year by hook and line. You can harvest them all by draining.

The draining of a pond must be done carefully. First allow the pond to drain down fairly low with a screen across the pipe. Then remove the screen and as the remaining water flows from the pond, catch the fish below the dam as they come through the pipe. You can collect fish and sort them easier if you will make a fish trough of hardware cloth on a wooden frame. One end is left open to fit over the drain pipe below the dam. The upper side is left uncovered. This is far better than trying to catch the fish inside the pond with a seine. It avoids mud and takes every fish.

A drain is also handy to lower the water if any repairs or added work becomes desirable. It keeps the pond from filling until construction is completed and clearance of the site is finished.

HOW TO BUILD A GOOD POND

Many farms have no suitable site for a good pond. You will make a mistake to build a pond on a poor site. You will find it worth while to consult your local soil conservationist on site selection and construction features.

The size of a pond is important. Remember, you may expect to catch about 50 pounds of bass and 150 pounds of bluegills a year, from each acre of a well-fertilized pond. Unless you allow friends to fish or wish to sell fishing rights, an acre or two will be large enough for your family. Whether your pond is large or small, it can be managed with the same practices. The crop of fish will be proportionate to the size of the pond. A pond of less than one-fourth acre is of course too small to furnish much fishing. Most important: The site you choose will largely determine the size of your pond.

A pond cannot be managed well if considerable water flows through it. It cannot be fertilized if it becomes muddy with every rain. If the pond has lots of shallow water at its edge, you will have trouble with weeds.

Some farms and ranches have several ponds. Usually one will supply all the fish you can use. It is better to manage one pond well than to produce in several ponds more fish than you can use. With the experience gained in managing a single pond, it is easy to handle another if you need more fish.

The following sections discuss the important things to look for when you choose a place for a manageable fishpond. Essential features of construction are explained. Thus you may be sure of a lasting pond with good fishing for yourself, your family, and friends.

CHOOSING A LOCATION

Before you start to build a pond make certain that the soil will hold water. It must be suitable for the pond bottom as well as for the dam.

The best sites occur in small valleys or depressions that have steep sides and gradually sloping floors (fig. 6, *A*). The steep sides assure deep water at the edge and make weed control easy. A gently sloping valley floor makes it possible to impound considerable water with a dam of moderate height. Such sites are often naturally wet and are

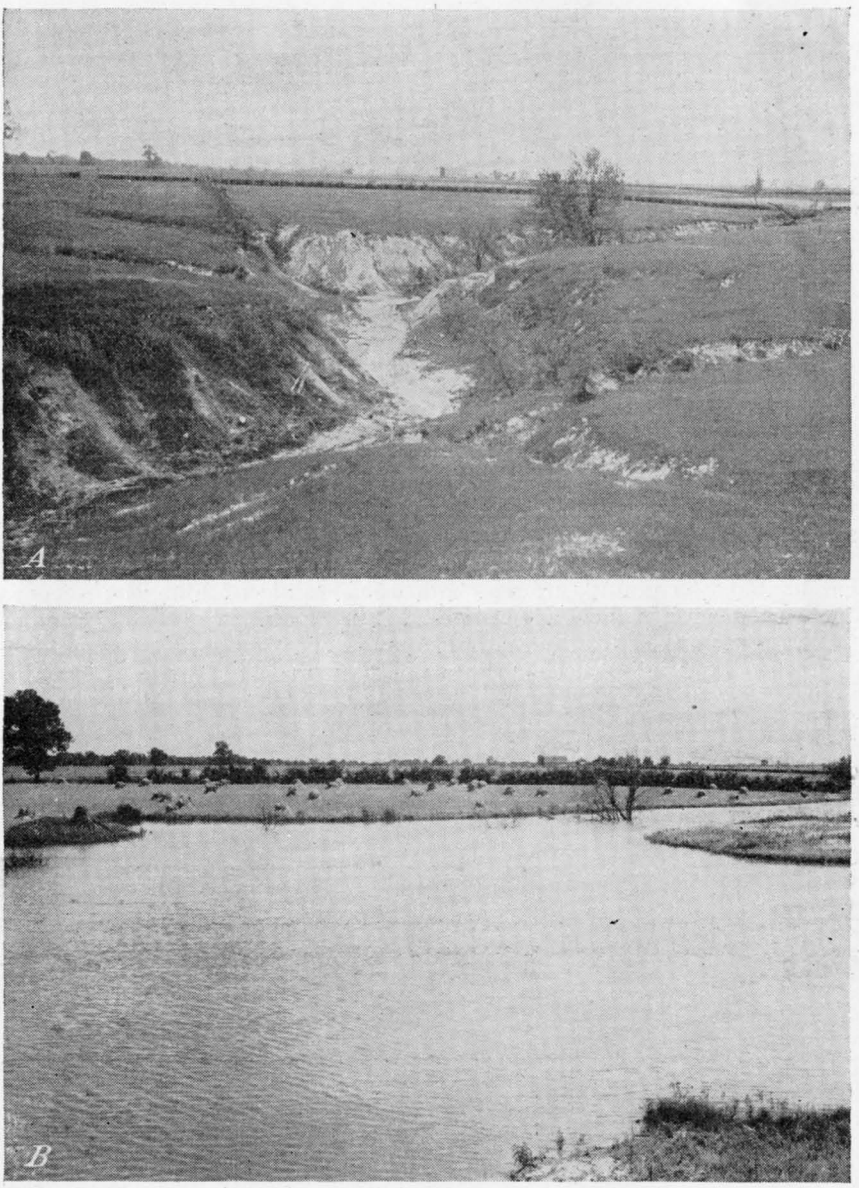

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FIGURE 6.—A pond provides good use of land. *A*, This gully destroyed productive soil. *B*, A dam across the gully converted it into a useful farm pond.

used better for fishponds than for cultivated crops or pasture. Even on small areas suitable for pasture or woods, a fishpond will often be the best use of the land, particularly if the completed pond will also supply water for livestock (fig. 6, *B*).

A site suitable for a good fishpond has a watershed from which little runoff water and silt will enter the pond. The basin should impound very little shallow water. Of course it must have a suitable supply of water. You should avoid sites on streams that carry much flood water. A steep valley floor will require too high a dam. You won't want to fertilize a pond so large that you cannot use all the fish.

The best location for the dam and spillway will also influence the size of your pond. A dam should not be raised at the sacrifice of a good spillway location just to increase the size of a pond. Two small dams can sometimes be built at less cost than a large one, yet provide an equal area of water.

Perhaps the most common fault in locating a pond is selecting a site with too much running water, or with too much floodwater during heavy rains. Ponds on such sites cannot be built cheaply or managed well for fish. Large quantities of water require masonry spillways which are not discussed in this bulletin. Too much running water or floodwater will wash the fertilized water out of the pond and replace it with less fertile water. Excess water also carries more silt into the pond and more fish out of it. Ponds can often be protected by turning excess water around the pond through a diversion ditch.

Good ponds can be built without a supply of running water. They require only enough runoff water to fill the pond and replenish the water lost by evaporation and seepage. To keep the water free from silt, soil conservation measures must be applied to the land. Exact acreages of watershed cannot be given here as there is considerable variation in annual rainfall and in the runoff from different soils and various slopes. Roughly, 10 to 12 acres of pasture and cropland or 30 acres of woodland will yield sufficient runoff water to maintain a pond of 1 acre in the Eastern States. In areas of the West, where the rainfall is light, larger acreages are required. In the Southeast and Midwest a number of soils are such that only 2 or 3 acres of pasture land may supply sufficient water for a 1-acre pond regardless of the depth. In any case, talk with your soil conservationist. He can help decide the acreage of the watershed you need as he is familiar with your local soils and conditions.

Where small streams, wells, or springs provide the water supply, a pond depth of 6 feet is sufficient, although 8 feet at the deeper end is usually better. Where the only supply is runoff from terraced fields or from woodland or pastures a depth of 8 feet or more must be planned for the pond, since the water level will fall in dry season. A minimum depth of 8 feet is also required in regions where long, cold winters will form 3 or more feet of ice.

The best pond site on a farm is sometimes without a supply of water but within reach of a small stream that you can divert into the basin. Some type of control gate must be used in the diversion ditch where it leaves the stream, to prevent floodwaters or muddy water from damaging the ditch and the pond.

An ideal pond site should provide the following:

1. A good reservoir in which to impound water.
2. Soils that are suitable for the pond bottom and the dam.
3. A water supply as uniform as possible.
4. A depth of at least 6 feet if the water level remains constant; and a depth of 8 feet or more if the water fluctuates 1 foot or more, or if heavy ice will form in the winter.
5. A moderately small watershed, to avoid excess water; and one that is protected so as to keep runoff waters free of silt.

CLEARING THE SITE

Leaves, dead branches, and other floating vegetation clog the spillway, harbor mosquitoes, support pond scum, impair fishing, and destroy the neat appearance that should be maintained. Contrary to popular opinion, logs, stumps, and brush are not needed to aid spawning or to protect young bass and bluegills.

After the pond site has been located, you should stake the proposed water line with the aid of a level. All trees, shrubs, and bushes should be cut from the area to be covered with water. A strip 15 feet or more back from the water's edge should also be cleared of brush and trees as they are not desirable at the edge of managed ponds (fig. 4).

Every tree and stump should be pulled from the actual site where the dam is to be built. Topsoil or other material high in organic matter should also be removed to insure a good bond where the earth fill joins the foundation soil.

INSTALLING OVERFLOW AND DRAIN PIPES

Vegetated spillways are least expensive for farm ponds; but they are difficult to maintain because of constant saturation of the spillway. An overflow pipe, connected with the drain pipe by an elbow or T-branch, is a way to fix the normal water level and to help protect spillways from failure. All of the normal overflow and much of the runoff water can be carried through the drain pipe, thus permitting safer use of inexpensive spillways. The top of the standpipe should be 4 or more inches below the level of the flood spillway.

Cast-iron, steel, or wrought-iron pipes are commonly used for drains. Cast iron is more expensive but lasts longer than either steel or wrought iron. A pipe known as "asbestos-cement" is also satisfactory; it lasts well and costs less than metal pipe of equal size. Vitrified-clay sewer pipe is economical and lasts almost indefinitely; but it is difficult to lay to avoid breakage as the dam or its foundation settles. Concrete pipe can also be used. Clay and concrete pipe should be laid on concrete cradles and the sections joined with concrete or with a flexible material such as plastic-asphalt cement.

Pipe 6 or 8 inches in diameter makes a serviceable drain for ponds of an acre or two. Larger pipe is much better for larger ponds, particularly where considerable water is to be bypassed through the drain. Pipe as small as 3 or 4 inches is reasonably satisfactory for small ponds.

The drain should be placed so as to allow complete drainage of the pond. A dug pond, of course, cannot be drained. In partly dug ponds the drain should be placed low to remove as much water as possible. The best drain is placed so that every bit of water and all the fish are brought through the pipe. Fish can be collected more easily below the dam than above it. If the drain pipe leaves shallow undrained pools, most of the fish will collect in them and become imbedded in mud. A syphon is less satisfactory than a drain pipe as a means of removing water and fish from a pond.

Pipe should not be laid above the bottom elevation in an attempt to allow for deposits of silt. No accurate estimate of siltation can be made, but silt should be negligible in a good pond. Moreover, the rate of silt deposit is least at the deep end.

BUILDING THE DAM

A common fault in constructing earth dams is that of making the base not wide enough to allow for adequate slopes and top width. The height and size of a dam depend on the location of the flood spillway, the top width of the dam, and the slopes of its sides. The specifications given here are general but they illustrate principles of safety and economy for dams up to 12 feet high. For designs of higher dams and spillways on watersheds above 50 acres, an experienced engineer should be consulted.[2]

A dam with a wide base and gently sloping sides is much stronger than one with a narrow base and steep sides. Seepage of water through the dam is decreased; and the chances of caving and slipping, when saturated with water, are reduced.

A good top width protects a dam against failure by wave action. You can expect muskrats to come into your pond but you need not worry about them if the top of your dam is wide. You can fill up the occasional burrows that break in from the top. Let the boys trap the muskrats in season for their skins.

A dam with the same degree of slope on both sides and a good working width on top is easiest to build.

As a general recommendation for low dams to be built of *good* material, 2-to-1 slopes on both sides are economical and reasonably safe. A top width of 7 feet is enough where teams are used in construction. Tractor equipment, such as bulldozers, rotary scrapers, and carriers, need a top width of 10 or 12 feet. The base width of a dam is four times its height plus the top width if 2-to-1 slopes are wanted. The length of pipe to be laid for a drain can be figured in this way.

Not every pond site has good soil available for the dam. Where less favorable soil is encountered, the slope of dam on the pond side should be increased to 3 to 1. These extra-broad bases are needed also for dams of above moderate height and dams that impound

[2] For further information see: Hamilton, C. L., and Jepson, H. G., Stock-Water Developments: Wells, Springs, and Ponds. U. S. Department of Agriculture Farmers' Bul. 1859. 77 pp., illus. 1940. Also National Resource Committee. Low Dams, a Manual of Design for Small Water Storage Projects. 431 pp., illus. Washington. 1938.

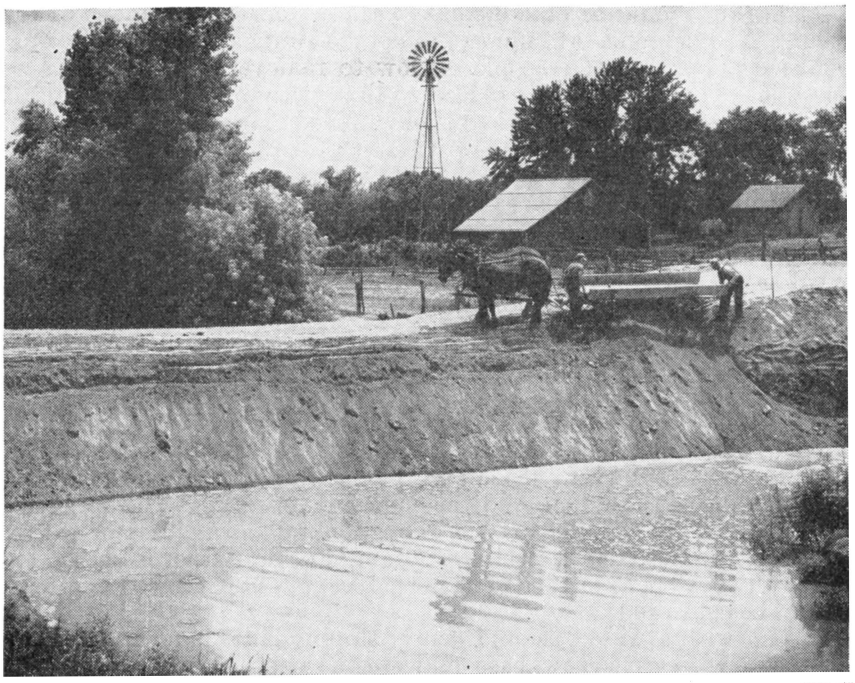

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FIGURE 7.—A good dam can be built with ordinary farm equipment.

several acres of water, as their failure may endanger life and property below. Undercutting these specifications for earth dams is false economy; and will result in need for frequent repair, if not in complete failure of the structure.

A dam must be high enough above the normal water level to prevent water from overtopping it during sudden or heavy rains. A height of 2 feet above the water level is safe for dams up to 12 feet in height if (1) the watershed is no more than 25 acres, and (2) an adequate flood spillway is provided. Three feet or more is needed where larger watersheds are involved.

A good foundation for the dam should be prepared before piling loose earth on the site. This is done by removing all stumps, roots, vegetation, and trash, and then removing all topsoil. This scooped-off area should then be broken with a turning plow to insure a good "seal" between the old earth surface and the new fill.

Soils deposited by nature in the bottom of draws contain sand and organic matter which make these soils porous and allow water to seep through them rapidly. A clay core-wall is needed to cut off this seepage beneath the dam.[3] The core is prepared by first digging a trench across this washed-in material. The trench should be 4 to 10 feet wide and dug down to a watertight soil (usually clay subsoil). It must extend the full length of the dam—even up the slope at each

[3] When the dam is placed on a rock foundation, a masonry or concrete cut-off wall should be used.

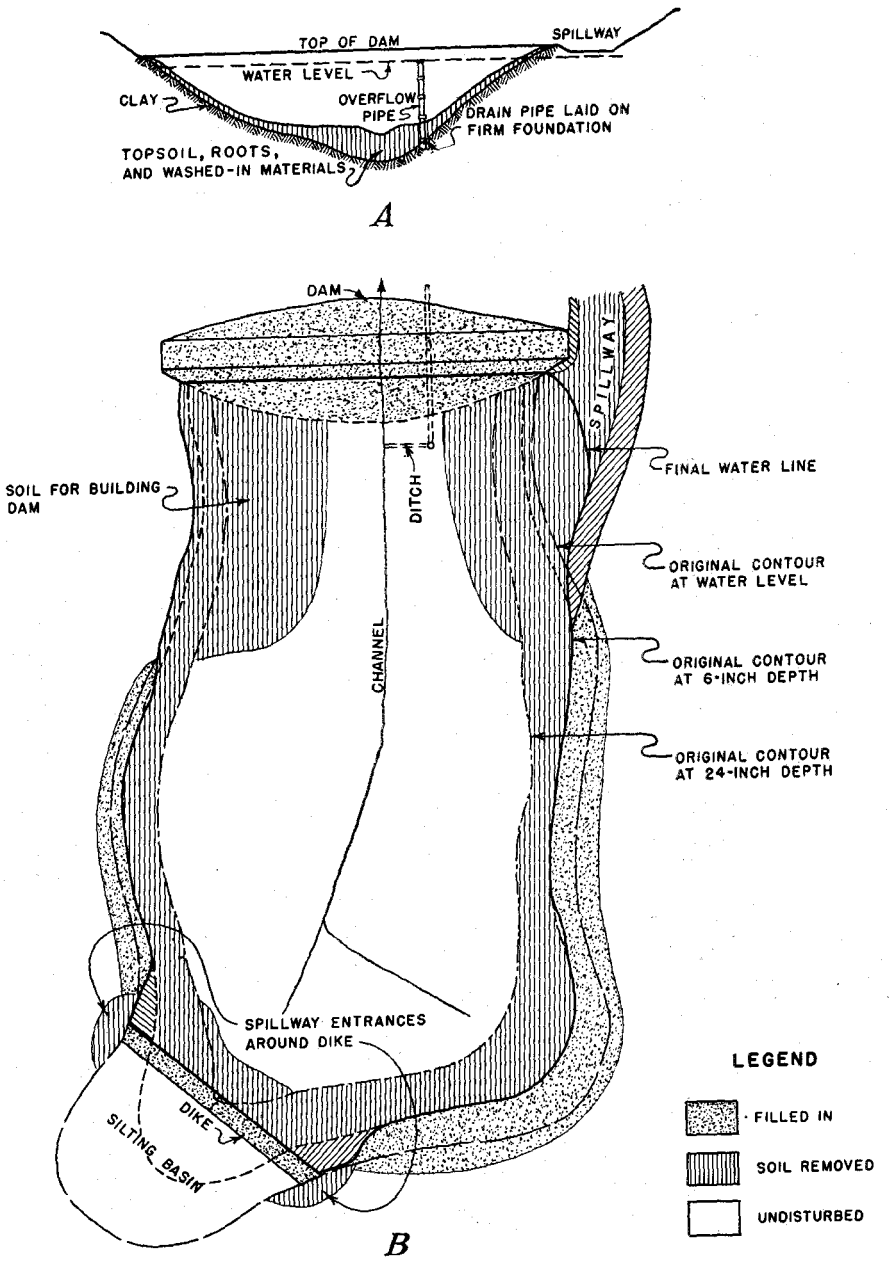

FIGURE 8.—Care should be used in properly locating the drain pipe and the areas from which the soil is to be taken. *A*, Shows relative elevations of drain pipe, clay subsoil, porous soil material, water level, spillway, and top of dam. *B*. Shows areas to be cut and filled, including edges to be deepened, and diking.

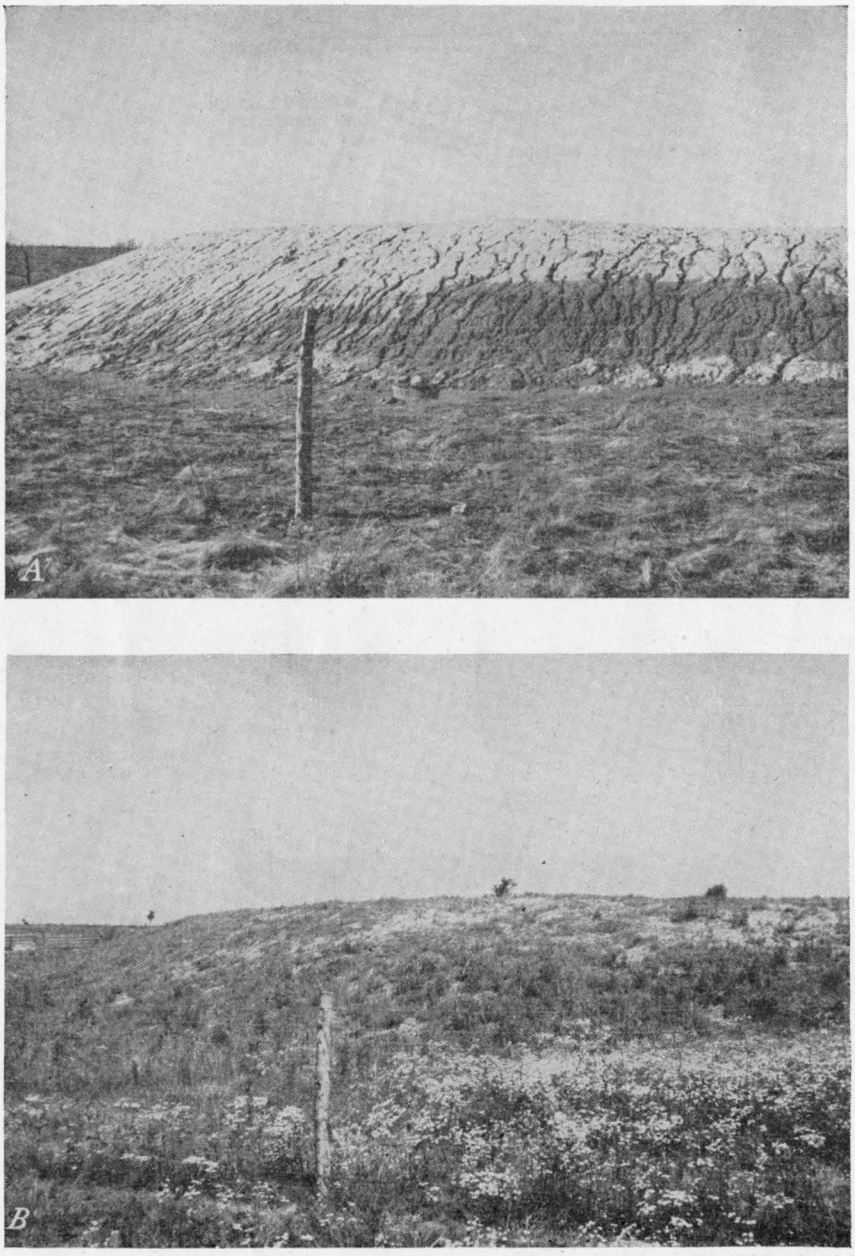

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FIGURE 9.—*A*, A portion of an unvegetated dam, showing the rills formed after a rain; *B*, the same dam protected by mulching and seeding with grass.

end. The trench is then filled with good clay soil. If the dam is to be built of porous soil material, the core wall must be carried on up inside the dam to above water-level height. When soils for the dam contain clay, the core wall need only be brought to the top of the core trench to join with the bottom of the fill. *A core wall is desirable where a constant flow of water will maintain a stable water level; but this cut-off wall is absolutely necessary to avoid loss of water by seepage from ponds that are fed by runoff water alone.*

The tools at hand will largely determine the way you move the soil. You may use teams and drag pans; they make a well-packed dam (fig. 7). Bulldozers, rotary scrapers, drag pans powered by tractors, steam shovels, or trucks are faster and are suitable for large jobs.

The dam will settle several inches after it is built. Settling is greatest where the fill is deepest. After the dam has settled, more soil is usually needed to even up the top so that the dam will have no low places in it. The best fill is placed in uniform layers of earth 4 to 6 inches deep, keeping each layer as nearly level as you can across the entire dam. You should complete one layer before starting the next. Moist soil makes the best compacted fill.

You can improve your pond and the dam can be built at less cost, if you take the soil for the fill from areas within the pond and from the flood spillway (fig. 8). If you remove soil from above the water level, you leave an exposed subsoil that is ugly and hard to revegetate. Of course the spillway must be dug, in most cases. The best clay and the shortest hauls are often obtained near the dam from one or both sides of the basin. You should mark the water level around the pond and begin taking soil from the line downward, leaving a steep slope at the edge. No pocket should be left at a lower elevation than the drain pipe, if avoidable.

As soon as possible after the dam is completed you should get some kind of vegetation growing on it (fig. 9). A sod grass, or a standard pasture mixture, or other adapted vegetation will protect the fill from erosion and wave action. Plants with long tap roots should not be planted or allowed to grow on earth dams.

THE FLOOD SPILLWAY

A good spillway is just as important as a good dam. *Few people build their spillways wide enough.* A wide spillway allows floodwater to leave the pond as a shallow flow that can be lowered to the stream without washing out grass sod. The loss of fish is negligible in a flow up to 3 inches deep.

Do not put a fish screen across the spillway. Screens become clogged with fine trash and endanger the dam.

Sometimes a natural spillway is available. If not, one can be cut from the hillside at either end of the dam. The soil from a flood spillway is close to the dam and should be used in its construction. Thus, extra-wide spillways reduce the cost of a dam and increase the safety in one operation.

If a large spillway cannot be built at one end, small ones can be built at each end to accommodate the water that would ordinarily be carried by a large spillway. Care should be taken to leave the floor

of the spillway almost level. Erosion can be prevented by a good sod of grass. The load on vegetated spillways can be reduced by an overflow pipe attached to the drain pipe.

You should not leave a raw open bank on the sides of a spillway as erosion will deposit silt in the spillway. Your local soil conservationist can tell you the best grass or legume for these banks. The slope of the bank should be no steeper than 2 to 1.

Remember: A spillway can hardly be too wide.

DEEPENING THE EDGES

Water less than 2 feet deep has little or no value to fish. Shallow water is troublesome. It grows weeds. Almost every pond can be

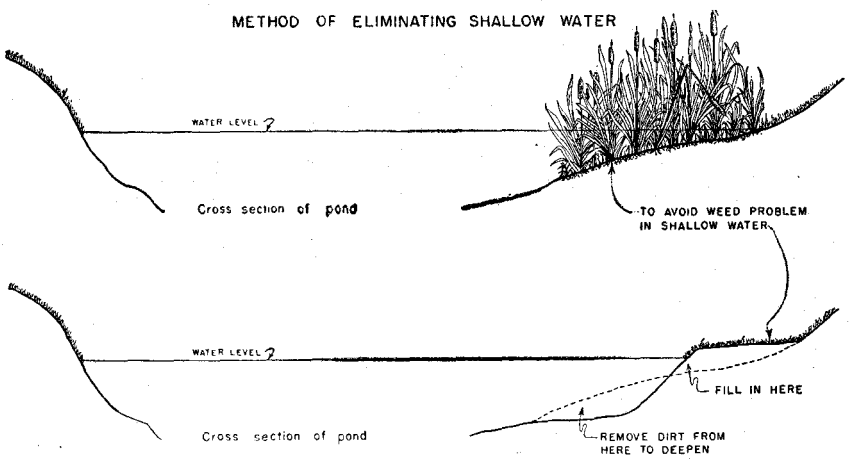

FIGURE 10.—Pond edges should be deepened to control emergent water plants and improve fishing.

made better for fish production by deepening the edges (fig. 10).

It is easier than you may think to deepen the shallow places. Of course you will avoid shallow areas near the dam by using the soil to make the fill. Away from the dam, deepen by digging out the areas that are 6 to 24 inches deep and filling the areas that are less than 6 inches deep. To do this job, three levels are staked: one at the natural water level; a second at the 6-inch depth; and the third at the 24-inch depth. The strip between the 6- and 24-inch depths is then plowed, and the soil scooped out and moved to above 6-inch-depth line. This soil will fill the shallow edges and leave a flat bench about 6 inches above the water level. Thus all the 6- to 24-inch depth is increased to 2 feet; and the less than 6-inch depth is filled up.

Deepening to 3 feet instead of 2 is better for ponds which are fed only by runoff water. In this case, the 1-foot and 3-foot levels are used instead of 6-inch and 24-inch depths.

Deepening is needed wherever the distance from the shore to a depth of 2 feet exceeds 10 feet. Diking is usually preferable where the distance from the shore to a depth of 2 feet is more than 30 or 35 feet. This is explained in the next section.

It is much easier to manage your pond when the edges have been deepened. You can pull any water weeds that start from the edge. Mosquito larvae will be caught by the little fish. Bass will keep little fish down to reasonable numbers. Fishing from the banks will be good all around the pond. Livestock will trample less of the shore and make less muddy water.

DIKING THE SHALLOW END

The drainage entrance at the upper end of a pond often slopes very gently. In such cases there is considerable area of water less than 24 inches deep. This area can be diked off from the pond, and weeds can be controlled more easily. The dike, raised a foot or more above the normal water level, should cross the pond where it is about 2 feet deep unless a narrower place is available close to this level. (See fig. 8.)

You get soil for the dike from the pond basin and thus deepen it. Runoff water is allowed to enter the pond around both ends of the dike, where wide spillways are left for this purpose. The unfilled area above the dike will eventually fill with silt.

As noted in the foregoing section, a dike may be used to eliminate shallow water along the sides; if the shallow area is too wide to cut and fill economically.

Diking, like deepening, is a refinement in pond construction, but both are worth more than they cost. On sites that are not good because of too much shallow water, successful ponds can be made only by deepening the edges and diking the shallow end.

THE FINISHED POND

Your finished pond should have these features:

A site selected to make good use of the land.

Steep sides to avoid water less than 2 or 3 feet deep.

A depth near the dam of 6 to 8 feet if the water level remains constant or an 8- to 10-foot depth if the water level will be lower in dry seasons.

A small or regulated water supply. Water from fields, woodland, or pasture is satisfactory if the runoff is silt-free.

All trees, shrubs, and debris cleared from the pond area and from a 15- or 20-foot strip around the pond edge.

A permanent drain and overflow pipe so placed that water can be drained out if need arises, and large enough to carry at least the normal flow of water without using the flood spillway.

A well-built dam and an adequate spillway to prevent damage by flood waters.

An attractive appearance unmarred by excavations above the water line other than those for the flood spillways.

PROTECTING THE POND FROM EROSION

The life of a farm pond depends largely on whether the lands above the pond are protected from soil erosion (fig. 11). The work and expense of building the pond, stocking it with fish, and managing it will be wasted unless the watershed is protected against erosion. When silt fills a pond it becomes useless; this often ruins the only suitable pond site on the farm. There are many effective erosion-control measures that will prevent this silting. You should use all of those that are needed on your particular watershed.

More than half the rainfall often runs off eroded land and carries a load of soil as it rushes down the slope. As land continues to erode, it becomes less fertile. The fertility of the water entering the pond decreases too. A good cover of vegetation protects the soil and holds it in place. It reduces runoff by allowing more of the rain to filter into the soil. When fed from a watershed on which adequate soil conservation practices have been applied, a pond receives water that is nearly silt-free and contains considerable natural fertility.

Although partial control of soil losses may lengthen the pond's life, it will still fail to produce a full crop of fish if the water is muddy. This is particularly true where clay soils make up the watershed. Large amounts of food for fish cannot be produced in muddy

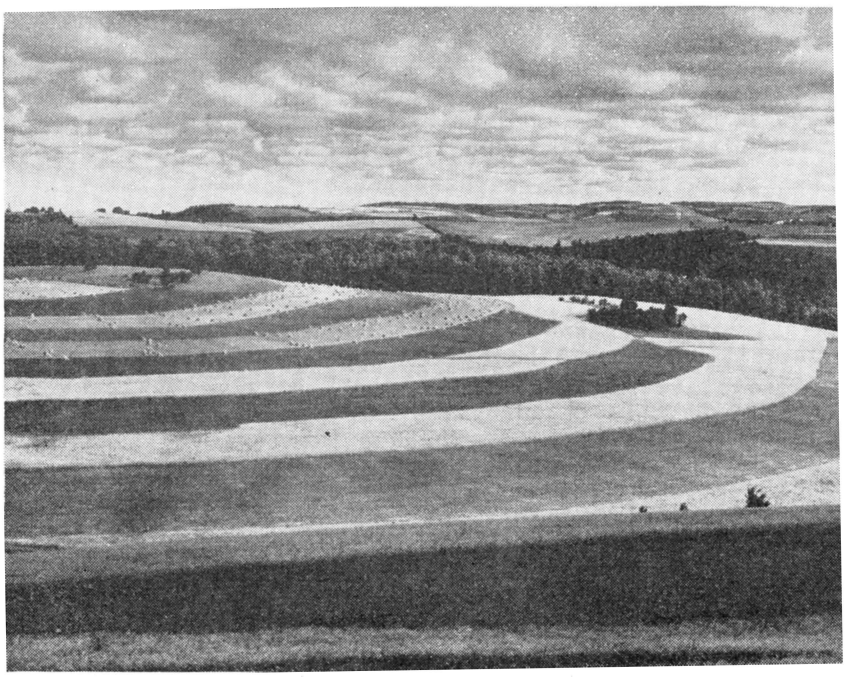

FIGURE 11.—The land above the pond should be protected from erosion by strip cropping and other soil-conserving practices.

water. You cannot fertilize it successfully. A pond, therefore, should not be built until soil conservation practices have been established. If land in the watershed is poor and eroded, it may require two or more years of conservation treatment before a pond can be constructed safely. A diversion ditch is one way to run both floodwater and silt around a pond. This is often done successfully. Erosion and runoff water, however, can be controlled most effectively at their source—*on the land where the rains fall.*

WHERE TO CONTROL EROSION

If you are to protect your pond against the damages of erosion you will need soil conservation practices on the watershed, whether the land is used as cropland, hay land, wildlife land, pasture, woodland, roads, or any combination of these (figs. 12 and 13). You should consult your local soil conservationist about this.

Sloping croplands need a complete system of crop rotations, cover crops, contour cultivation, terraces, and meadow outlets. These practices reduce sheet erosion, prevent gullies, and provide vegetation to break the force of the rain and to strain the silt from excess waters as they flow down the slope. They permit more rainfall to filter into the soil.

The steepest croplands need deep-rooted hay plants to prevent further erosion of the soil and destruction of ponds below.

Good pastures keep runoff water nearly free of silt. Heavy sods result if you apply fertilizer and lime properly; and if you control the grazing. The right kinds of grasses and legumes for your local conditions are important features of soil conservation in pasture management.

Woodland gullies contribute a surprising amount of unwanted silt. These gullies develop when fires, grazing, and concentration of water from other areas remove protective ground cover (fig. 14).

If you have any of these erosion problems, ask your soil conservationist for help. Your pond needs protection.

Field and woodland borders, odd corners, rock outcrops, and numerous other small areas are suitable primarily for the production of wildlife cover and food. They too should be protected by plenty of vegetation. Unless such land is protected by the right kinds of plants, these areas contribute silt. You will be surprised how muddy a pond can become from a very small bare spot. Besides keeping the soil out of ponds, the shrubs, vines, legumes, and grasses recommended for wildlife lands provide desirable foods and shelter for songbirds, game birds, and rabbits. Wild fruits for home use can also be harvested from these wildlife lands.

Heavy silt enters ponds too often from private and public roads. Road water should be diverted wherever possible. Roadbeds, except those that are hard-surfaced, erode rapidly. Individual farmers can reduce erosion by keeping their farm roads on the contour and protecting the sides of roads with vegetative cover. Assistance of soil conservation district, county, and State officials will be needed to control erosion along public roads on watersheds above ponds.

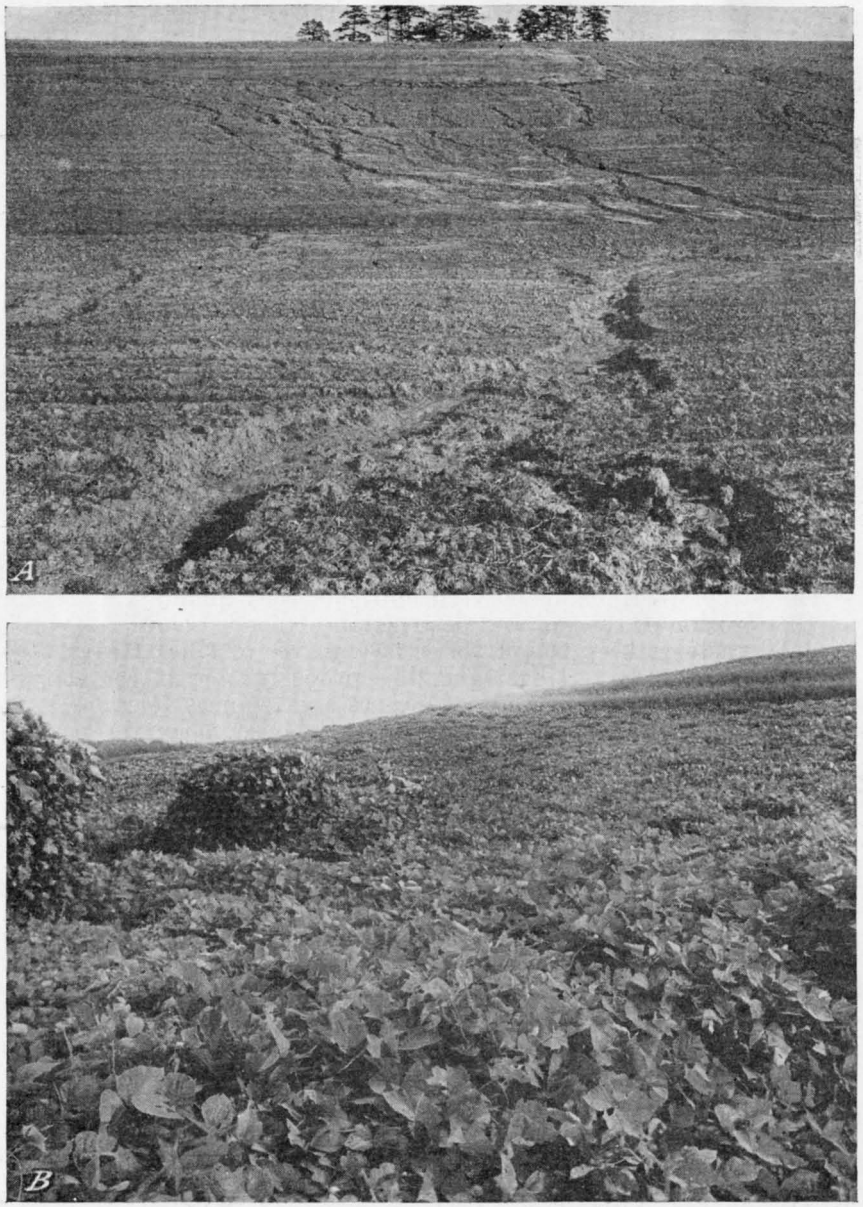

FIGURE 12.—*A*, Critical slopes, when clean tilled, erode and become unproductive. *B*, In the South, kudzu or sericea lespedeza is a suitable perennial to hold soils in place, increase fertility, and produce excellent hay.

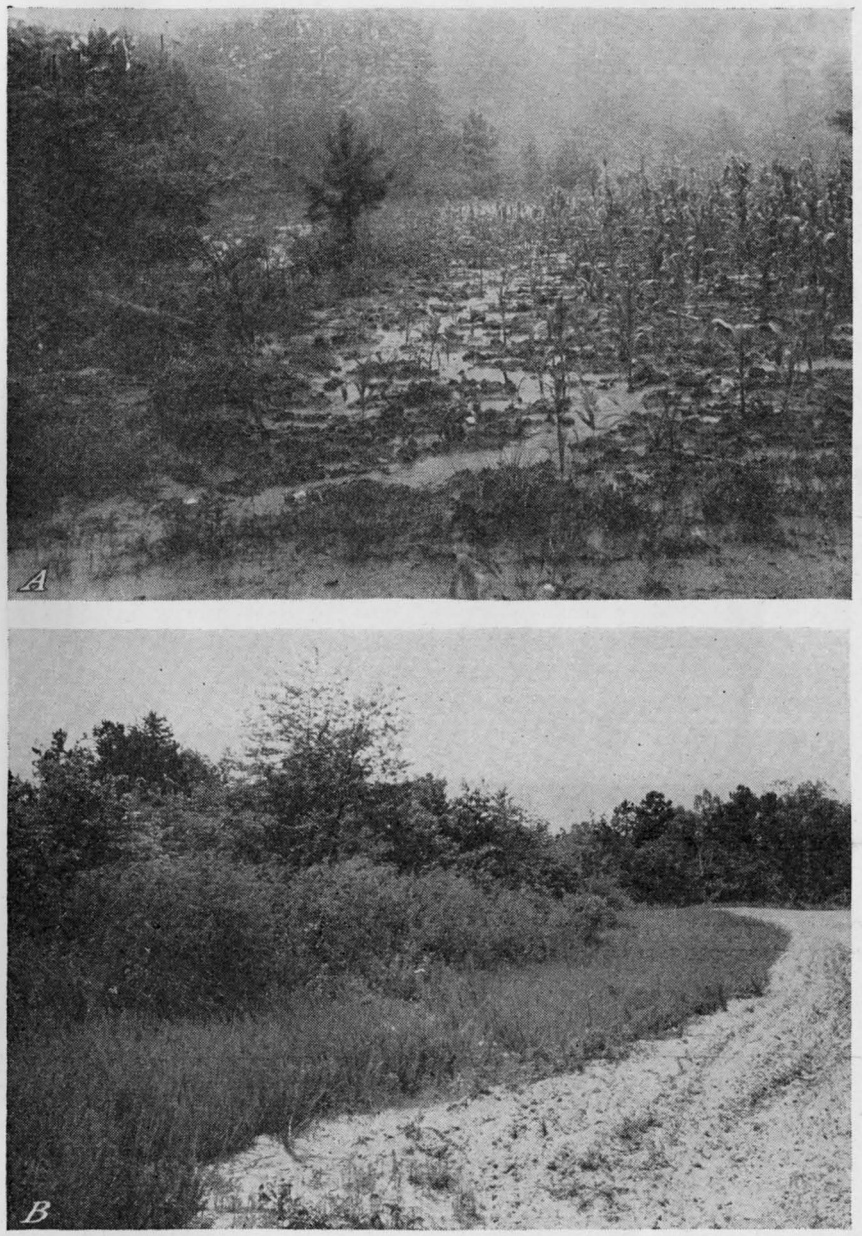

FIGURE 13.—*A*, The unproductive edge of a field supports practically no crop and permits serious erosion. *B*, Wildlife borders of shrub and sericea lespedeza solve border problems for southern farmers.

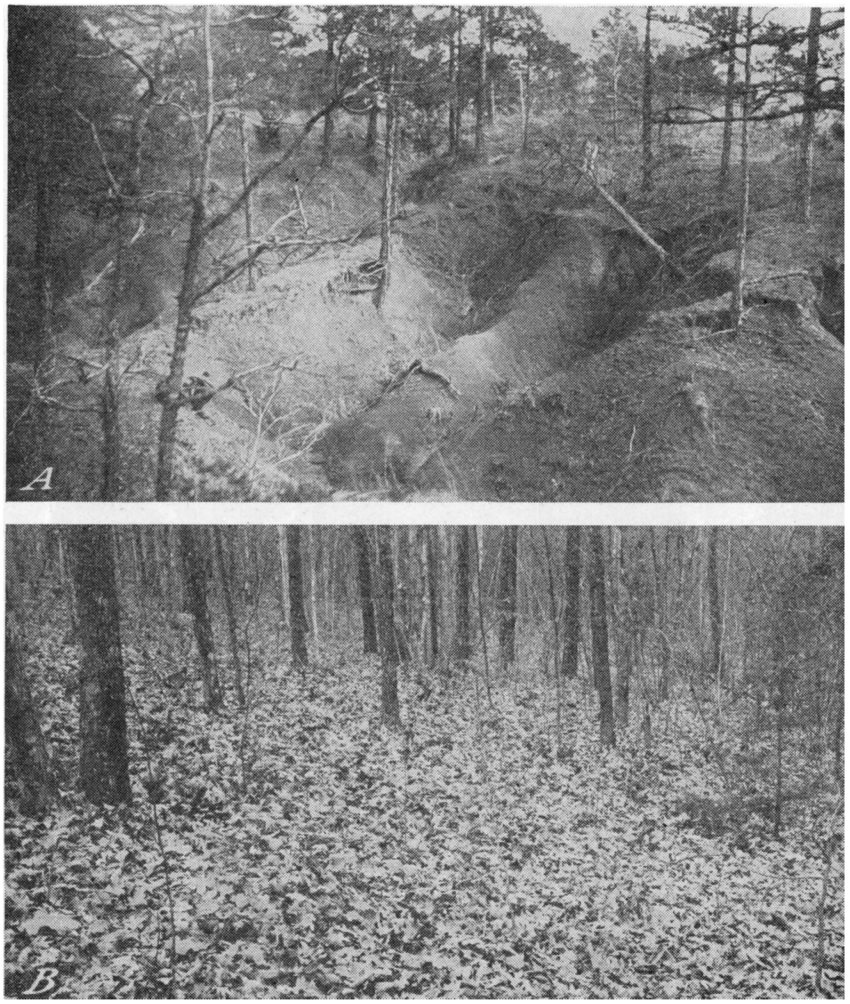

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FIGURE 14.—*A*, Woodland gullies develop when fires, grazing, and concentrations of water from other areas remove protective ground litter. *B*, The litter that accumulates on the ground, rather than the trees or their roots, most effectively controls the erosion.

OLD PONDS AND SMALL LAKES

Old ponds can be brought into good production of fish by fertilization and weed control only if the pond itself is suitable and has the right balance of bass and bluegills.

Some old ponds can be made good by draining. You can then remove all fish; install a drain pipe; make the spillway and dam better if needed, remove brush, debris, and dead trees from the banks and pond area; and deepen the shallow areas. If it cannot be drained

easily, the fish can be poisoned and the pond restocked. After renovation the pond can be stocked, fertilized, and managed as recommended for new ponds.

Good-sized lakes can be constructed and managed in the same way as ponds. They are suitable for fishing clubs or groups. Anyone with sufficient capital to meet the expense of construction and fertilization might sell enough fishing rights to make a profit and thereby remove usable fish as fast as they reach proper size. The management of a large pond or lake often presents more problems than do small farm ponds. Erosion, floods, and siltation are greater hazards on large watersheds. The dam and spillway construction require more money and engineering skill.

Farmers, on the other hand, can build and manage small ponds with ordinary farm equipment and materials. Erosion and floods are controlled on small watersheds by good farming measures. The dams and spillways are simple to design and construct. The proper numbers of fish for stocking are not hard to obtain. Removing water plants and keeping the pond banks in good condition are not difficult chores. The pounds of fish you can produce in your own good pond will be profitable and pleasant to use.

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